

A warning that a "biological revolution" is already under way was given to a standing-room-only audience at Downstate on September 16 by Dr. Joshua Lederberg, Nobel Laureate in Medicine, the first Visiting Scholar of the academic year.

Dr. Lederberg, who is Professor of Genetics at Stanford University School of Medicine, spoke on "The Human Use of Genetics." The biological revolution caused by rapid advances in the application of new scientific knowledge to human affairs "is not something that is about to happen. It is well under way," he said.

Thus far, there are two major trends in the use of biology to influence our species on a global level, Dr. Lederberg said. One is the "spectacular" reduction in the death rate that has caused a "transient population explosion." While reproductive patterns in the industrialized nations have been altered to adjust for this change, the adjustment is yet to be made in the underdeveloped nations, Dr. Lederberg said.

The second, related trend, he said, is the "perception that in this new world that man has helped to create, he has the will and the responsibility to assert control over his reproductive patterns." There is "nothing on the human horizon" to compare with the impact of these two trends, Dr. Lederberg said, although changes are coming on "a very large and very powerful scale."

But Dr. Lederberg said he cannot share "the unusual sense of horror, futility, and novelty" expressed by many persons when they discuss the possibility that the new biological knowledge may be used to change human characteristics. While this scientific knowledge may one day permit biologists to change man's physical characteristics, Dr. Lederberg said, society already exerts powerful influences on our no-less-important acquired traits.

"We are constantly shaping human nature," he said. "Everything we do to a child is a shaping of human nature in its most important aspects. Educators are also involved in the modification of human nature. This physical modification is no less important than genetic modification."

This does not mean, Dr. Lederberg said, that we should ignore the moral implications of the biological revolution. They should be looked at "in the context of all our relationships with other human beings," he said.

Already, he said, some profound moral questions are being raised by new discoveries. One of these is the development of a test to detect carriers of the recessive gene



## NOBEL LAUREATE SPEAKS

ON

### "HUMAN USE OF GENETICS"

that causes cystic fibrosis, a disease that is invariably fatal. The gene occurs in one of every 20 persons in the United States, and when two persons with the recessive gene marry, one-quarter of their children will have cystic fibrosis.

"But what use should we put this information to?" Dr. Lederberg asked. "Should there be changes in our marriage policies? If two people with the recessive gene are married, should we insist they have no offspring? Should we have compulsory divorce?"

One possible future answer, he said, would be early prenatal diagnosis of the fetus to discover whether the disease was present. If it was, there could be "an early abortion, so that the parents could try again."

A similar problem has been raised by the finding that the presence of an extra "Y" or male sex chromosome in some men is related to violent crime. Some four percent of the inmates of an institution for the criminally insane have been found to bear the extra Y chromosome, Dr. Lederberg said. He called this "a very strong bit of information on the relation between the genetic constitution and sociopathological behavior."

What is needed now, Dr. Lederberg said, are detailed studies that would give closer correlations between behavior and biochemical characteristics of individuals. There have been some scattered studies of blood groups and personality traits, but their results have been doubtful, he said. There is a similar lack of knowledge about intelligence, he added.

"Our present position on the genetics of intelligence has been unaltered for the past 40 years," Dr. Lederberg said. "We have at best poor instruments for measurement of intelligence, and no assay for the intellectual potential of a child. We stand at an impasse at the present time in trying to find the genetic basis of intellectual performance."

Even if diagnostic tools are found to detect such things as intellectual potential or genetic disease, Dr. Lederberg said, "there would still be the basic question of what practical measures could be taken."

Dr. Lederberg defended the use of "retrospective abortion"—aborting a fetus that study showed to be genetically defective—on the grounds that "we might feel more confident about what we are contributing to posterity if women knew what they were carrying." Abortion would be objectionable only if it were forced on a woman by the state, he said.

While he is concerned with the possible misuse by the government of biological knowledge, Dr. Lederberg said "it is only a small part of the concern I feel over the existence of modern weaponry, which has given the state the power to eliminate all life on earth." The only difference with biological weapons, he said, "is that we need a more alert electorate to maintain our freedom," because of the more subtle nature of these methods.

An additionally troubling factor is the development of more deadly methods of biological warfare, Dr. Lederberg said. "The engineering of viruses for war is a sad inevitability in the present state of the world," he said, "No nation that is involved in the development of military weapons can afford to disregard the possibility of this kind of biological warfare."

Dr. Lederberg acknowledged frankly, "I don't know what we can do about it, but perhaps the first thing to do is to present it to you as a problem in its own right, not a mere incident in history."

On the brighter side, engineering of viruses offers promise in meeting some needs of mankind, Dr. Lederberg said. He pointed out that some viruses, including the polyoma virus and a virus called SV40, have the ability to transform cells without killing the cells. While the transformation is harmful—the cells become cancerous—this ability could be used to change cells for the better, Dr. Lederberg said.

One possible use of this method could be in some genetic diseases, in which the patient lacks the ability to produce a specific enzyme. Biologists may be able to find a virus that gives cells the ability to produce the enzyme, and eliminate the condition by infecting the patient with the virus, thus giving his cells the ability to make the

virus. "And if we couldn't find the right viruses, we might be able to make them," he said.

Another method of genetic engineering could involve the use of a virus to add to the cell's DNA, the basic genetic material that governs living characteristics. By tagging specific DNA onto a virus, that DNA could become active in a living cell, thus changing the cell.

The first example of this kind of genetic engineering has just been reported by Dr. Stanfield Rogers of the Oak Ridge National Laboratories. Tobacco Mosaic Virus (TMV), which infects tobacco leaves, and which has RNA rather than DNA as its genetic material, has been altered by Dr. Rogers, who added a specific RNA sequence to the virus's normal sequence. Tobacco plant cells infected with the altered virus produced new substances—amino acid chains whose production was caused by the added RNA.

This type of genetic engineering may be used some day to improve plants, Dr. Lederberg said. He also suggested that it could be used to help fight the protein deficiency that is responsible for much of the world's malnutrition.

Proteins are made of long chains of amino acids, Dr. Lederberg said. Human beings must eat these proteins because we have lost the ability to make them within our bodies. Altered viruses might some day give human cells the ability to synthesize these amino acids, thus eliminating the need to eat proteins.

While all these possibilities probably can be achieved with enough time and effort, Dr. Lederberg said, it appears that those which are the most urgent will get first consideration—and considering the state of the world, that means the military uses of genetic engineering. Dr. Lederberg expressed the hope that the new biological information being amassed in the world's laboratories will be used peacefully, and not for war.

#### "The Human Use of Genetics"

by Joshua Lederberg

given September 16, 1968  
at Downstate Medical Center  
State University of New York  
Brooklyn, New York